

ON THE SINISTRAL CHARACTER OF THE SHELL OF *PLANORBIS*.

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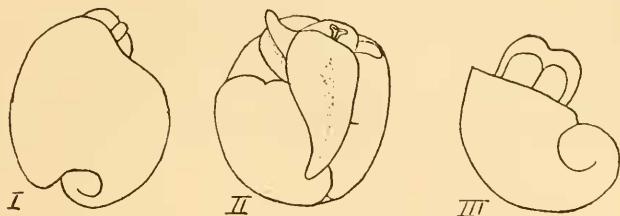
THE question as to whether the discoidal shell of *Planorbis* is dextral or sinistral has occupied the attention of many naturalists from the time of Linnæus. Although within recent years the researches of the late Dr. Paul Fischer fully confirmed the sinistral nature of this shell, yet many writers still maintain the opposite theory, and therefore a brief review may be acceptable to those interested in this subject.

Among the earliest writers we find that Linnæus, Müller, and Draparnaud considered the shell to be right-handed, whilst Cuvier adopted the sinistral view, basing his opinion on the anatomy of the animal. Somewhat later Des Moulins discussed the question, and having shown on what grounds he believed the shell to be dextral, went out of his way to prove the animal to be similarly coiled, in spite of his knowledge of the position of the external orifices. Previous to this Deshayes had formulated a law which stated that the more dilated portion of the peristome *always* indicated the upper side of a shell. This generalization, which holds good in shells of elevated spires, would, in the absence of certain other facts, tend to uphold the dextral character of *Planorbis*, and it is on Deshayes' law, together with the position of the shell in the living animal, that the dextral theory has been established.

About the time of Des Moulins, Jacquemin published his memoir on the development of *Planorbis*, and his figures being in every case reversed by mistake, the young shell is represented as right-handed. This unfortunate error remaining for a long time unnoticed, simply strengthened the opinion that the shell was dextral, as upheld by Moquin-Tandon, Piré, and others. In 1852 Naumann sought to establish the sinistral side of the question on mathematical grounds, a similar course, however, being taken thirty-eight years later by Pfeffer, in support of the opposing view.

On many occasions the embryos of *Planorbis* have been selected for the study of Pulmonate development, but in nearly every instance the observers have confined themselves to the changes prior to the appearance of the shell. However, in 1877 Paul Fischer decided to again examine the young shell of *P. corneus* and if possible prove its sinistrosity. Referring to the two authors who had figured the young shell, he says: "Les figures de Quatrefages sont insuffisantes pour décider si les embryons sont dextres ou sénestres; celles de Jacquemin montrent des embryons à coquille spirale dextre; mais toutes les planches de cet auteur sont fautives par la négligence du dessinateur, qui a transporté les dessins sur pierre sans les retourner. C'est ainsi qu'il représente un animal adulte de *Planorbis* avec ses orifices genitaux

et respiratoire à droite, bien que l'auteur affirme, dans l'explication des planches, qu'ils sont placés à gauche." As the result of his investigation, he found that an embryo 0.9 mm. in diameter was provided with a globular shell having a distinctly *left-handed* spiral. He therefore concluded that "les Planorbes ont une coquille spirale sénestre chez l'embryon, et discöide sénestre chez l'adulte, l'animal restant toujours sénestre."



I. and II. Embryos of *Planorbis corneus* (after Fischer) showing sinistral spiral shell.

III. Embryo of *Limnæa*, sp. ? (after Fischer) showing dextral spiral shell.

Some two years ago, whilst studying this question, I examined a number of the eggs of *P. corneus* (not being aware at the time of the existence of Fischer's paper), and found the young shells were undoubtedly sinistral. I also examined an older specimen about 4 mm. in diameter, where the flat discoidal stage had been reached; in this the sides of the peristome were equally developed, thus showing no bias in either direction. Three weeks later, when about 6 mm. in diameter, the shell had begun to assume the more adult appearance, having one side of the mouth more dilated.

It has long been known that monstrosities occur in this genus, where the normal discoidal form is replaced by a shell having a raised spire. Such "heterostrophic" forms may be either sinistral, as in *P. leucostoma*, or dextral, as in *P. complanata*. According to Von Jhering, *P. leucostoma* may be regarded as atavistic, as representing the sinistral raised type from which the normal discoidal *Planorbis* has no doubt descended. The other forms, such as *P. complanatus* and *P. multiformis*, may be considered as stages in advance of the discoidal form, and so according to Von Jhering are "ultra-sinistral," a better term perhaps being *pseudo-dextral*. A similar view has been taken by Arnold Lang with regard to the genus *Ampullaria*, where we have raised dextral forms passing through discoidal into raised *pseudo-sinistral* forms, the spires having emerged on the umbilical sides of the *Planorbis*-like shells.

With regard to the apparently dextral character of the peristome of the adult shell of *Planorbis* and the dextral position of the shell in the living animal, these may be the first indications of a tendency to pass over into a pseudo-dextral form, which has been realised by *P. complanata*.

Leaving now the consideration of the shell, I will briefly note the sinistral characters of the animal of *P. corneus*. The position of the orifices on the left side has already been mentioned as distinctive of the sinistral Pulmonates, and has been known since the time of Swammerdam; but the studies of Lacaze-Duthiers have also shown us that, as in *Physa*, the left visceral ganglion is larger than the right, and that it gives rise to a left pallial nerve ending in an osphradium on the left side. This osphradium, moreover, possesses but *one* epithelial cœcum, whereas in all dextral Pulmonates, the right osphradium has *two* cœca, and the right visceral ganglion is larger than the left.

In conclusion I would add that, in studying the literature of this subject, I have been greatly indebted to Prof. G. B. Howes, Mr. M. F. Woodward, Mr. B. B. Woodward, and Mr. S. Pace.

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